NMFS Beaufort Lab Age Data Inputs for Stock Assessments:

Protocol for Ageing

The Beaufort Lab primarily receives fishery-dependent age samples from reef fish species of the SAFMC Snapper-Grouper FMP collected from commercial and recreational fisheries operating in the South Atlantic Fisheries Management Council's jurisdiction. Age samples were primarily collected by the Headboat Survey port agents starting in 1972,. In the 1990s, commercial age samples from the NMFS Trip Interview Program (TIP) port agents started to arrive. By the early 2000s, state agencies of Florida, South Carolina and North Carolina started sending commercial and recreational age samples to the Beaufort Lab. Since 2005, the Beaufort Lab has received approximately 20,000 age samples per year from 70 different species of fish. A conservative estimate of the total number of age samples received and inventoried to date at the Beaufort lab is 200,000. Of the samples received, approximately 121, 100 have been processed and aged, the remainder sit in an ever-growing archive. The data from the processed samples have been included in peer-reviewed publications, reports, and graduate student theses. Since the SEDAR process started in 2001, 75% of all the aged fish have been directly used in SEDAR stock assessments (Table 1).

Samples and inventories:

Upon receipt of the samples, they are logged into sample inventories. Sample inventories document individual records for each sample, which include lengths, weights, gear, and landing and effort information. We receive electronic data from the various source programs, as well as hard copy data sheets. The commercial samples collected through TIP are inventoried through the Bio-Sample Database (BSD), which is housed in Miami and linked directly to the TIP database. (See BSD Procedure Manual _Artech.pdf.) The collections are checked to ensure the correct number of samples per species in each interview has been received, and the individual tag numbers are randomly checked for accuracy. Sample envelopes are only labeled with interview ID and individual sample number (tag number). All accessory data (e.g., length, date, etc.) are not included on each envelope, thus we assume that electronic data for each sample has been recorded correctly. Hard copy data sheets, if provided, are filed for future reference.

All other samples provided to the Beaufort Lab are logged into an Access database housed at the Beaufort Lab (BFT). Electronic data for each individual sample is meticulously verified. Errors are brought to the attention of the collector to rectify; errors generally are found in less than 3% of annual samples. Because state agencies and separate NMFS programs each have their own variable codes (e.g., species codes, state, gear, fishing area, etc.), all data are standardized to TIP format for consistency. (See BFT_inventory_user_guide.doc provided as a background document).

These current inventory procedures have been in use since 2009 for the BFT and 2010 for the BSD. Prior to those dates, an inventory of our age samples did not exist. As a result, much time has

been spent logging in historical samples and verifying data associated with each sample. For example, staff have just completed logging in scamp otoliths collected as long ago as the 1980s that total more than 10,000 individual records. Other important species have yet to be completely logged in due to time constraints and lack of staff to complete the task and still meet SEDAR schedules.

Some of the samples received at the Beaufort Lab are redistributed for processing and aging. For example, there is a cooperative arrangement with the Florida Fish and Wildlife Conservation Commission (FWC) personnel to provide all yellowtail snapper, mutton snapper and black grouper age samples to them.

Table 1. Number of age samples currently stored at the Beaufort Lab and number of processed samples used in SEDAR stock assessments by species.

Species	Number of samples processed and aged	Number currently stored unprocessed
Red porgy	5526	3717
Vermilion snapper	27785	11376
Gag	4699	5693
Gray triggerfish	3696	3628
Snowy grouper	5543	3145
Red grouper	6723	3225
Tilefish	4318	2393
Blueline tilefish	3004	1127
Black sea bass	16896	266
Red snapper	10435	483
Greater amber jack	1726	509
Yellowtail snapper	6241	Shipped to FWC
Mutton snapper	1785	Shipped to FWC

Processing Protocols:

Age samples from fish have primarily included sagittal otoliths (hereafter referred to as otoliths), spines, and scales. With the exception of menhaden, very rarely are scales used for aging reef fish species. Most reef fish species are aged from otoliths. Due to the shape and difficulty extracting otoliths from triggerfish species, the first dorsal spine is used for age determination. Protocols for processing age structures are agreed upon by collaborating laboratories for consistency. Beaufort Lab's collaborators include the South Carolina Department of Natural Resources MARMAP group, NMFS Panama City Laboratory, North Carolina Division of Marine Fisheries, Georgia Department of Natural Resources, Florida FWC, and several universities. MARMAP is our closest collaborator and generally with whom we align for our processing techniques and age readings.

Processing protocols between collaborating labs are based on several criteria. Basic protocols include which age structure to use, whether to use whole or sectioned age structures, and optimal

thickness of sections. Each lab may have slightly different machines for processing. Overall, however, consistency in the final sample preparation quality between labs is a primary goal rather than the equipment used to obtain that preparation. We exchange processing techniques with our collaborators to ultimately achieve the most efficient processing with the best quality. See the SEFSC Panama City Lab AGR Manual 2008 info.pdf for specific description of processing techniques provided to the Review Committee.)

Age Reading/Interpretation:

The Beaufort Lab staff participates in individual species age workshops with collaborating labs for consistency in age readings of the same species. These workshops are conducted primarily for new species on the SEDAR schedule, because the labs will be combining data sets from fish from the same population. After the participating labs have agreed on processing protocol and discussed interpretation of the growth zones on the age structures, the labs exchange reference, or calibration, sets of age structures. Data obtained from all the readings are analyzed for consistency in readings and possible bias in age readings. If a significant bias exists that would impede the combining of age data sets, then another age workshop may be necessary. The reference document "SEDAR32_DW03_Kolmos_etal.1.29.2013_Final.pdf" provided as a "must read" details the process for determining age consistency between labs and addresses bias issues. Additional examples, including for red snapper and black sea bass, are included as background documents.

The reference sets are maintained at each lab for future use. When new personnel are hired, they are trained in processing and age reading. Then, they read the reference collections to ensure consistency of readings. Due to the small number of staff at the Beaufort Lab trained to age fish, each age sample is read once. The large number of samples do not allow for multiple readings of the same age sample. This fact makes the reference sets even more important with regards to consistency of age readings.

Age of each fish is based on several criteria. Age readings begin with annual increment counts and a measure of the type of margin on the age structure. The margin, or edge, codes indicate whether there is an opaque zone on the margin or some amount of translucent zone. Based on the margin code, time of year when the opaque zone is formed, and month of capture of the fish, the increment counts are converted to calendar ages. The conversion of increment counts to ages varies by species. Not all fish exhibit a clear pattern of opaque zone formation. For those species, the age of the fish is the increment count.

Unfortunately all the age determinations are based on the assumption that each identified increment represents an annual mark. This has not been c validatedfor fishes processed and aged in the SAFMC jurisdiction with the exception of tilefish. Because of the heavy reliance on age data for the commonly used age-structured models in SEDAR, the lack of age validation remains an important source of potential bias and uncertainty.

At the Beaufort Lab, age data are recorded in the BSD or the BFT, so that all accessory dataare linked to each sample. Work is in progress to house all fishery-dependent age data in the BSD. The age

data with accessory information is extracted from the inventories and provided to SEDAR through the Data Workshops to be included in the stock assessments. During the Data Workshops, the various labs providing age data will combine data sets, ensuring consistency in variable coding with metadata included. These combined age data sets are maintained with all other SEDAR data inputs for each specific species on a SEDAR server.

Storage of processed age samples:

After age readings have been completed and the data have been vetted through the SEDAR process, the processed samples must be stored. If an age validation study has been conducted on a species that changes the interpretation of the structure, then previously processed samples can be reread. For example, following an age validation study on tilefish, which is a difficult to age fish, all labs went back and re-aged old samples. The age structure input to the assessment model was greatly improved.